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BIOCHEMICAL STUDIES OF THE LARVAL HOSTS OF TWO SPECIES OF *LYCAENA* FABRICIUS[1] (LYCAENIDAE)

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INTRODUCTION

Although The Hopkins Host Selection Principle (Hopkins 1916, 1917) relating larval host plant specificity and speciation in insects has been discredited (Wood, 1963; Mayr, 1969), many lepidopterists persist in citing larval host preference (plant species) as a basis for separating butterfly species. In the course of a study of the lycaenid butterfly complex *Lycaena dorcas* Kirby and *L. helloides* (Boisduval), I examined some of the biochemical properties of their larval hosts. East of the Rocky Mountains, the two species are allopatric and phenotypically separable. Larvae of *L. helloides* use the Polygonaceae (*Polygonum, Rumex*) while *L. dorcas* appears restricted to *Potentilla* (Rosaceae). *L. dorcas* is univoltine while *helloides* is multivoltine. From the Front Range of the Rockies westward to California and north to Alaska, numerous *dorcas/helloides* phenotypes occur which reflect altitudinal and latitudinal gradients. The published host plant studies (Chambers, 1963; Shapiro, 1974) indicate oviposition on either *Potentilla* or the Polygonaceae under laboratory conditions. In the field, distinct preferences are apparent. To gather information for a taxonomic revision of this butterfly group (to be published separately), samples of *Rumex, Polygonum* and *Potentilla* were subjected to various analyses with the results reported below.

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METHODS AND RESULTS

Botanically the Polygonaceae and Rosaceae are rather disparate families. Ehrlich and Raven (1964), and Dethier (1952) have discussed olfactory adaptation and some of the chemical attractants involved in insect selection of oviposition substrate. The flavonoids are one of the classes of compounds cited. Accordingly, plant specimens were examined for biochemical commonalities and the presence of flavonoids. Specimens of *Polygonum amphibium* L., a known host of *L. helloides* in McHenry Co., Illinois, were obtained from that locality. *Potentilla fruticosa* L., a known host for *L. dorcas,* and *Rumex triangulivalvis* (Danser) Rechinger, a suspected host for *L. helloides* in eastern Wyoming (females in association with the plants) were obtained from the Sherman Range, Laramie Mountains, Albany Co., Wyoming.

Extracts were prepared by soaking the leaves over night in 95% ethanol. Equal weights of leaf material were suspended in equal volumes of alcohol, although no quantitative measurements were attempted. The extracts were then scanned over the range 200-750 nm using a Beckman 25 double-beam scanning spectrophotometer with the extracting alcohol as a blank. The spectral signatures for the three samples are shown in Figure 1. Except for concentration levels, they are nearly identical. The absorption at ca. 670 nm is chlorophyll; the weak absorption at ca. 550 nm and the broad absorption centered about 350-370 nm are unclear. The seemingly weak absorption lines at 250-260 nm (note that there has been a 20:1 vertical scale change in the traces) represent flavonoid compounds, as subsequently confirmed; the very strong absorption at ca. 210 nm is characteristic of organic oxygen compounds.

To confirm the presence of flavonoids, two-dimensional descending paper chromatography studies were conducted using Whatman no. 1 chromatography paper. 46 x 57 cm sheets were used with the alcohol extract sample spotted in one corner. Solvent 1 indicated as the vertical axis in Figure 2 was by volume 3 parts tertiary butyl alcohol, 1 part glacial acetic acid, 1 part distilled water. The 57 cm paper length was used for this 24 hour run. For the 4-5 hour horizontal axis run, 15% glacial acetic acid was used. The R values were determined, by reading the dry chromatogram over ultraviolet light, and plotted (Fig. 2).

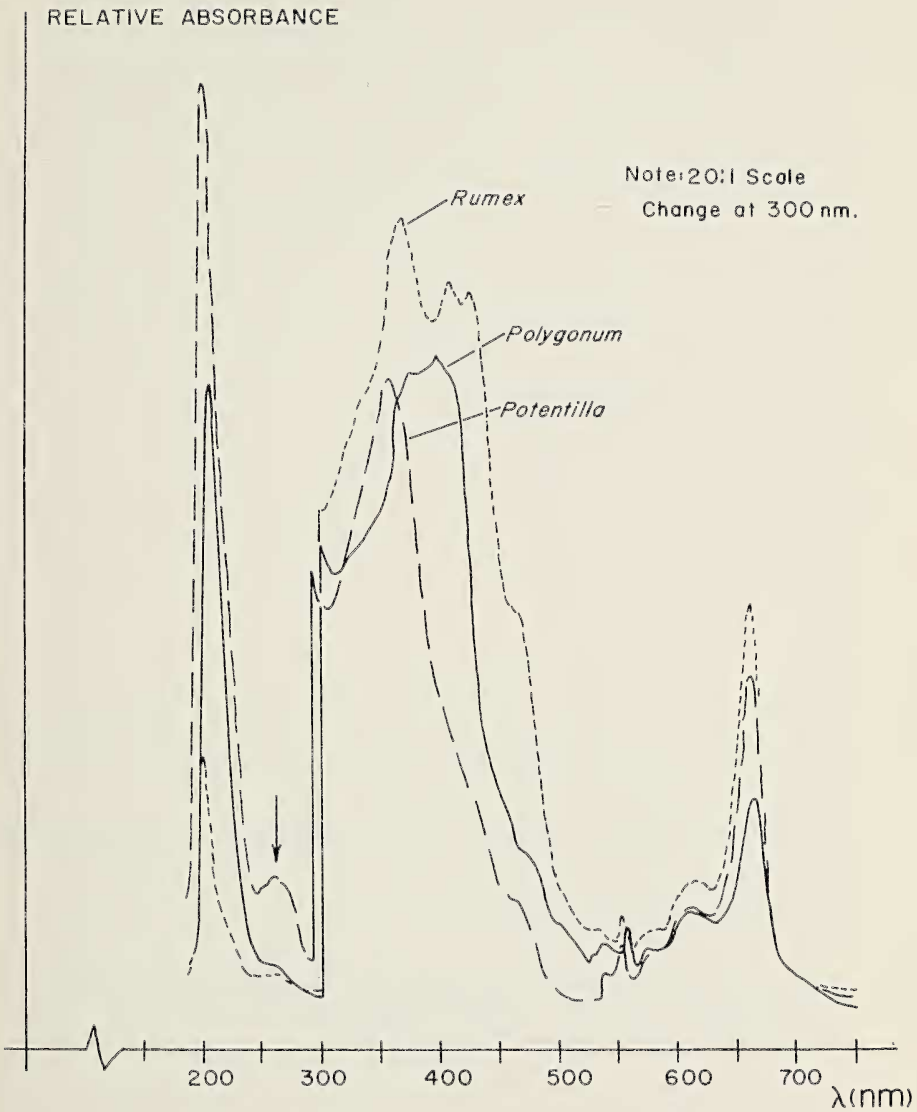

Fig. 1 — Spectral signatures of the three plant species studied. The arrow points to flavonoid absorption.

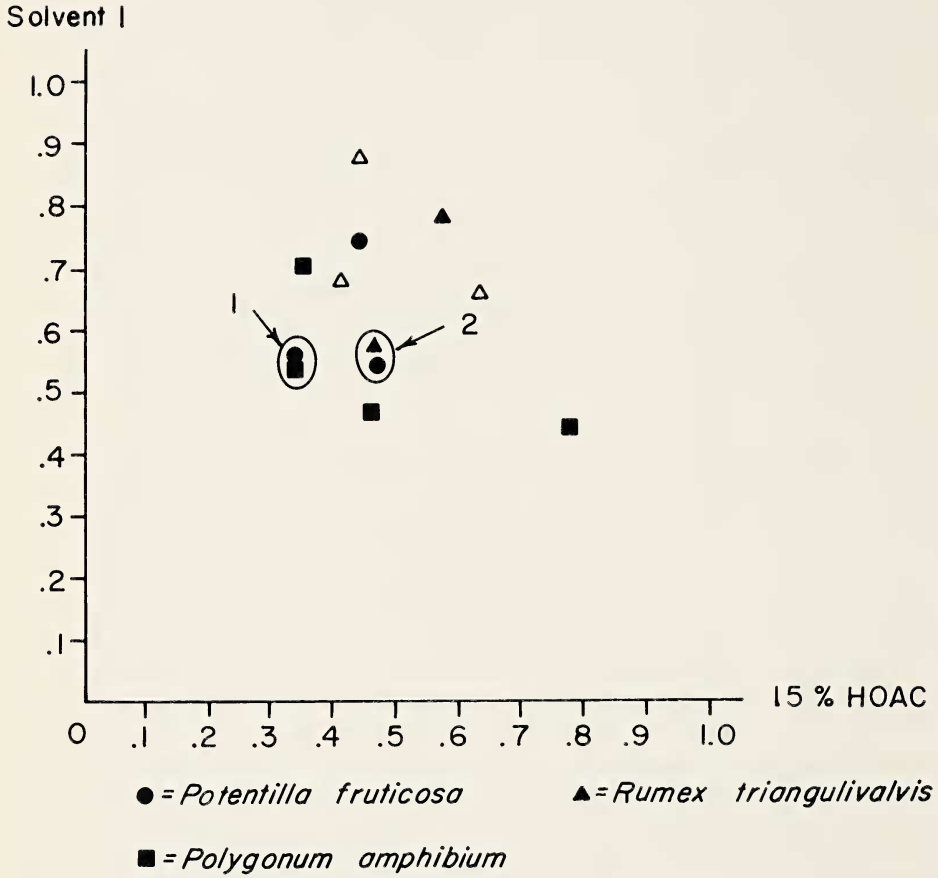

Fig. 2. — Two-dimensional chromatogram of the compounds present in the three plant species studied. The axis coordinates are the R values. The open triangles represent non-flavonoid compounds.

The solid symbols represent flavonoid compounds, probably flavones ($C_{15}H_{10}O_2$) which appear as "dust" on leaves and stems. As a further check, the spots indicated by "1" in the figure were eluted with methanol and scanned spectrophotometrically. Both exhibited strong absorption at ca. 252 nm, characteristic of flavonoids, and both absorbed strongly at 210 nm, characteristic of organic oxygen compounds. No other spectral lines were detected over the range 200-750 nm.

Steam distillations of freshly collected samples of the *Potentilla* and *Rumex* were conducted to recover any volatile oils. This was not done for the Illinois *Polygonum* specimens, as they were of insufficient volume and had dried out. The very small amounts of residue obtained were dissolved in chloroform and spectrophotometrically scanned. Both exhibited strong absorption lines at ca. 250 nm, characteristic of a benzene ring aromatic, probably a flavonoid. Both curves also exhibited a "knee" at ca. 260 nm, indicating that probably two compounds with slightly separated absorption lines were present. Chromatographic cross checking was not possible because of the very low concentrations of the samples.

CONCLUSIONS

Biochemically, *Rumex, Polygonum* and *Potentilla,* used as larval hosts by *L. dorcas* and *L. helloides,* are very similar. *Potentilla fruticosa* and *Polygonum amphibium* appear to contain a common, or very closely related, flavonoid compound as shown in Figure 2. Within the accuracy of paper chromatography, *P. fruticosa* and *R. triangulivalvis* may also contain a common flavonoid as indicated by "2" (Fig. 2). The volatile oils study indicates that *R. triangulivalvis* and *P. fruticosa* are very similar. Based upon the spectral signatures (Fig. 1), one would expect that *P. amphibium* also has a similar volatile component, since all three plants exhibit absorption lines characteristic of benzene ring aromatics.

If females of *L. dorcas* and *helloides* depend upon olfactory stimuli in host plant perference, then it would seem that either *Potentilla* or *Polygonum/Rumex* could be selected as oviposition substrates. This has been demonstrated under laboratory conditions as noted above. Based upon this study, it would appear that in some cases the basis for selection of oviposition substrate and larval host in the monophagous and oligophagous Lepidoptera is biochemical similarity of plants and not their taxo-

nomic placement. Depending upon environmental conditions and olfactory adaptation in a given butterfly colony, a particular host is preferred, but rather disparate plant species may be quite similar biochemically and thus found suitable.

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